tion. The songs of the folk are classified under the heads of narrative ballads, love and mystic songs, pastorals, the songs of the poacher and the highwayman, the soldier and the sailor, the pressgang, hunting, sporting and labour songs, carols, singing games of children, the popular street ballad, and the broadside.

As for the folk-dance, much of the knowledge which we possess is due to the enthusiasm of Mr. Cecil Sharp, who has hunted down the veteran dancers, and taught them how to instruct the minor societies which have been started in almost every large centre. The authors deny that the Morris dance is connected with the Moors, and prefer without good reason a Celtic derivation which makes it to mean "noble." The suggestion that it may be in part due to the Salii or leaping priests of Rome is hazardous; there is more to be said for the theory which connects some of the figures with a primitive sun-worship. The sword-dance seems to be derived from some primitive rites of fertility. The manual is a good introduction to the subject, and the bibliography and illustrations leave little to be desired.

Masonry as Applied to Civil Engineering. By F. N. Taylor. Pp. xi+230. (London: Constable and Co., Ltd., 1915.) Price 6*s.* net.

THE early part of this book contains descriptions of the various kinds of stones used in civil engineering, together with the methods of working and handling them. This portion cannot be described as altogether complete in itself; there are many references to another book by the same author. There is a certain off-hand manner in the treatment which has led to one, at least, unfortunate result. On p. 23 calculations appear giving the load which can be raised by a set of Weston's blocks when a given pulling force is applied. No allowance has been made for friction, hence the result of the calculation is altogether misleading.

In the later portions of the book the author deals with retaining walls, dock walls, dams, bridges, towers, monolithic and block concrete construction, shoring, and underpinning. It is probable that the reader will derive more benefit from the descriptions and drawings given in these portions than from the very brief theoretical discussions and calculations. On p. 43 there is an illustration showing a surcharged wall, together with a few lines of description supposed to indicate how to obtain the thickness of the wall. There appears to be some omission in the illustration; it is impossible to grasp the author's meaning. The treatment of the wedge method on p. 45 is imperfect, and again there appears to be omissions in the illustration.

In general, the author gives formulæ without any explanation of how these are derived. We do not think, therefore, that the book is likely to meet the requirements of modern students, who, for the most part, desire to be perfectly clear regarding the derivation, limitations, and assumptions involved in any formula which they are called upon to use in design.

LETTERS TO THE EDITOR.

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The Nature of Gas Ions.

OUR knowledge of the nature of gas ions is derived mainly from measurements of their mobility in an electric field. Experimental evidence has shown that as the pressure (p) is altered the mobility (k) of the ion alters generally in accordance with the law, pk=constant; when this law holds good it is safe to conclude that the ion remains unaltered at the different pressures. One of the most interesting results of experiment is that in the case of the negative ion formed in air the product pk increases as the pressure is diminished below about 10 cm.; this result indicates a simplification in the nature of the negative ion at the lower pressures. Prof. Townsend and his students have examined this phenomenon in great detail, and have come to the conclusion that the velocity (v) of the ion should be expressed as a function of the field (X) and the pressure (p) in the form $v=f(X/p)$, indicating that the nature of the ion depends on the field and the pressure. In his recently published treatise Prof. Townsend concludes that the negative ion in a dry gas is in general a cluster of molecules which for a certain range of electric forces and pressures passes through a transition stage until finally, when X/p exceeds a certain value, the negative carriers are practically all electrons.

In some experiments recently undertaken to determine the mobilities of the ions formed by the radiation from polonium in thoroughly dried air, I have been led to conclusions essentially different from those now generally held. From a pressure of one atmosphere down to about 8 cm. the results were normal; at pressures below 8 cm. the negative carriers were found to consist of two kinds, electrons and ions, the former increasing in number relatively to the latter with diminishing pressure. In no instance was there any evidence of an intermediate or transition stage, the separation between the faster and the more slowly moving carriers remaining throughout clear and distinct. I was able to measure the velocity of the negative *ion* at all stages until resolution between the two kinds of carriers was no longer practicable, and it was ascertained that the value of pk remained constant from one atmosphere down to the lowest pressure employed (1/7 mm.), indicating that the negative ion remains unaltered in nature over this wide range of pressures.

The fact that electrons exist in dry air at the lower pressures is, of course, well known, but at a pressure of 12 mm. the ions constitute at least 80 per cent. of the negative carriers and at 1/7 mm. more than 50 per cent. The proportion of ions and electrons depends solely upon the pressure, the effect of the field being for the most part small or negligible. For the negative ion at all pressures v was found to be directly proportional to X/p; there seems to be no necessity for introducing any unknown function of X/p.

The fact that the electrons travel through several centimetres of a gas at pressures as high as 8 cm. without attaching themselves to neutral molecules is remarkable, and seems to imply that the distribution of carriers between ions and electrons must be determined immediately after the act of ionisation; it would appear that the electron has to be fired into the mole-

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cule above a critical velocity, otherwise attachment is no longer possible.

It was found that the positive ion remains unchanged in nature down to 1/20 mm., which was the lowest pressure tried.

An account of these experiments will appear shortly in the *American Journal of Science*.

E. M. WELLISCH.

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New Haven, Conn., April 6.

Migrations in the Sea.

THE terms "anadromous" and "catadromous" are employed to distinguish fish which leave the sea to spawn in fresh water and fish which migrate from fresh water to the sea when they reach maturity. Gilson, in his paper, "L'Anguille" (1908, *Ann. d. l. Soc. roy. Zool. et Malacol. d. Belgique*, T. 43), proposed that the words should be used to define migrations to and from fresh water. The salmon, for example, is catadromous as a smolt, anadromous as a grilse, and so on. But unless new terms are to be created the words must be given a much wider significance than Gilson has suggested. The migrations of fish from the lower part of a river to the higher reaches, from a river to a stream, from the deep region of a lake to the shallows only differ in degree from the anadromous migration of the salmon. It cannot be said either that there is any difference requiring a new term in the migration of a fish from the sea into the lower part of a river or into an estuary. A fish which migrates from relatively deep water to the coast may also be said to have made an anadromous migration. There are species which may spawn in fresh or brackish water, and species which may spawn in salt or in brackish water. In short, it may be said that fishes present every degree of anadromous migration from mid-ocean to the upper limits of streams, and corresponding catadromous migrations. It is now proposed, therefore, that these words should be used to indicate the direction of the migration, however small or great that migration may be, whether passive or active, pelagic or demersal, seasonal or spawning.

But even with the wide meaning here suggested the words cannot be applied to an important feature of migrations in the sea—migrations brought about by current. The Gulf Stream is utilised by fish and other organisms for the conveyance of eggs and larvæ and young to, or towards, the continent, and its branches are no less importantly taken advantage of to convey the products from the spawning ground to a region which may be at some considerable distance. The drift may often be said to be an anadromous one, but it is sometimes catadromous, and frequently could not be defined by either term. The migration of the mature fish is in contrast to the drift of the larva.

This may be illustrated by reference to a species not a fish—the common edible crab, *Cancer pagurus*. The crabs on the east coast of Britain migrate, seasonally, catadromously from the coast for winter and anadromously to the shore region for summer. The mature females after ecdysis, sooner or later become ripe, and in response to the impulse thus conveyed migrate northwards along the coast. During or after this migration they become "berried." The larvæ, when liberated, are planktonic, and are carried by the current to the south. If there were, as there is some degree of evidence to show that there are, particular regions which present large associations of berried females, the young crabs would reach the bottom most numerously in areas to the south, which may be said to be related to the regions where the larvæ are liberated.

Thus with regard to this species there is a migration against the current of the mature females and a migration with the current of the larvæ, and these migrations are clearly quite distinct from the seasonal movements which characterise the species at the other periods of life.

The relationship of the spawning ground to the region where the demersal fry are deposited is better defined in the case of many of our species of flat fish and round fish, since it results in the formation of schools of seasonal migrants.

To define these and other migrations which are intimately associated with currents it is necessary, therefore, to introduce two terms which will serve to indicate movement against the current and with the current. My colleague, Prof. J. Wight Duff, recommends a Latin root, *natare*. The words suggested therefore are *contranatant*, swimming against the current, and *denatant*, swimming or drifting with the current. The words *contranatation* and *denatation* are also available to indicate the act or habit of migration against or with the current.

A. MEEK.

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A Mistaken Butterfly.

IN this connection the case should be recalled of the Cleopatra butterfly of southern France and Italy, the close relative of our English Brimstone. By waving a grass-green butterfly net in its vicinity I have frequently attracted the yellow and orange coloured males, which will flutter after the net and endeavour to settle on it. The female is similarly coloured to the female Brimstone, but is rather larger. A blue net fails to attract them.

G. H. BRYAN.

THE "CRACKING" OF OILS AND ITS COMMERCIAL USE.

THE great consumption of petrol as a motor fuel, which last year, in spite of the disturbing element of war, rose to the enormous volume of 120 million gallons in England, and to nearly ten times that amount in America, has led to the attempt being made to add to the natural supply by the so-called "cracking" of the heavy residual oils left after the petrol and the lamp oil have been distilled off from the crude oil.

The term "cracking" is one of those delightful Americanisms which express so exactly the meaning we wish to impart that it has been adopted universally—when a molecule is decomposed it is broken up: when it is merely resolved into simpler compounds it is "cracked." The term first came over with carburetted water gas, when the oils fed into the carburetting chamber were said to be "cracked," *i.e.*, converted into hydrocarbon gases of high illuminating value, but not "broken" into carbon and hydrogen.

A less violent form of the same operation can be utilised to convert the heavy hydrocarbon molecules in oil of high specific gravity and boiling point into volatile liquids fitted for use as a substitute for petrol. Most of the processes for doing this are based on a paper read by Sir Edward Thorpe and John Young before the Royal Society in 1871. This historical memoir was the first and only really scientific attempt to explain the actions that led to an increase in the yield of light hydrocarbons from a heavy oil under certain conditions of distillation, an action that

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